

U.S. DEPARTMENT OF AGRICULTURE  
FOREST SERVICE

SPECIFICATION

CLOTH, SHIRTING, ARAMID

1. SCOPE

1.1 Scope. This specification covers one type flame resistant aramid basket weave cloth.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those in effect on the date of the invitation for bids or request for proposals.

SPECIFICATIONS

MILITARY

MIL-T-44100            Thread, Para-Aramid, Spun, Intermediate Modulus

STANDARDS

FEDERAL

FED-STD-4        - Glossary of Fabric Imperfections  
FED-STD-191     - Textile Test Methods  
FED-STD-376     - Preferred Metric Units for General Use by the  
                         Federal Government  
FED-STD-802     - Packaging of Synthetic Fiber Fabrics

Military

MIL-STD-105     - Sampling Procedures and Tables for Inspection by  
                         Attributes

Beneficial comments (recommendations, additions, deletions) and any pertinent data that may be used in improving this document should be addressed to: USDA Forest Service, Missoula Technology and Development Center, Building 1, Fort Missoula, Missoula, MT 59801-7294 by using the Specification Comment Sheet at the end of this document or by letter.

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, Building 4D, 700 Robbins Ave., Philadelphia, PA 19111-5094.

2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those in effect on the date of the invitation for bids or request for proposals.

#### FEDERAL TRADE COMMISSION

##### Rules and Regulations Under the Textile Fabric Products Identifications Act

(Address requests for copies to the Federal Trade Commission, Public Reference Branch, 6th St. and Pennsylvania Ave. NW, Washington, DC 20580-0001.)

2.2 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those in effect on the date of the invitation for bids or request for proposals.

#### SEARS, ROEBUCK AND CO.

##### Sears Fabric Defect Replica Scales

(Address requests for copies to Sears, Roebuck and Co., "Fabric Defect Replica Kit," Department 817 (STTN: FC 554B), 3333 Beverly Rd., Hoffman Estates, IL 60179.)

(Non-Government standards and other publications normally are available from the organizations that prepare and distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

### 3. REQUIREMENTS

3.1 First article. Unless otherwise specified (see 6.2), sample cloth shall be subjected to first article inspection (see 6.5) in accordance with 4.3.

3.2 Standard samples. The dyed and finished cloth shall match the standard sample for shade and appearance and shall be equal to or better than the standard sample with respect to all characteristics for which the standard sample is referenced (see 6.3).

### 3.3 Cloth

3.3.1 Aramid fiber blend. The blend shall consist of 93 percent meta-aramid fiber, 5 percent para-aramid fiber, and 2 percent conductive fiber. The aramid fibers shall be 1.5 denier per filament and 1-1/2 to 2 inches in staple length, and shall not char at a temperature less than 675°F. The conductive fiber shall be a bi-component carbon core fiber sheathed with nylon and polyethylene and shall be 3 denier per filament and 1-1/2 to 2 inches in staple length (see 6.4).

3.3.2 Yarn. The yarn shall be spun into a two ply for both the warp and filling.

3.4 Color. Unless otherwise specified (see 6.2), the color of the cloth shall be bright yellow to match the standard sample (see 3.2) when tested as specified in 4.5.

3.4.1 Matching. The color of the finished cloth shall match the standard sample when viewed under filtered tungsten lamps that approximate artificial daylight having a correlated color temperature of  $7500 \pm 200$  Kelvin with illumination of  $100 \pm 20$  foot candles and shall be a good approximation to the standard sample under incandescent lamplight at  $2300 \pm 200$  Kelvin.

3.4.2 Dyeing and finishing. The dyed and finished fabric shall show good dye penetration of the fiber and colorfastness to light and to laundering equal to or better than the standard sample when tested as specified in 4.5. Pigment padding shall not be acceptable.

3.5 Physical requirements. The physical requirements of the finished cloth (see 6.4) shall be as specified in table I, when tested as specified in 4.5.

3.5.1 Weave. The weave shall be a modified basket weave as shown in figure 1.

3.5.2 Width. The width of the finished cloth shall be as specified (see 6.2) and shall be the minimum acceptable width inclusive of the selvage when fly-shuttle looms or shuttleless looms with a tuck-in selvage are used. For all other shuttleless looms, the width measurement shall be made between the last warp yarn on each side, excluding the protruding fringe(s).

3.6 Finishing. The cloth shall be desized, scoured, and heat set (see 3.6.1, 3.6.2, and 3.9).

3.6.1 Nonfibrous material. The starch and protein content including chloroform-soluble and water-soluble material of the cloth shall not exceed 1.0 percent when tested as specified in 4.5.

3.6.2 Curling. When tested as specified in 4.5.1, the finished cloth shall lie flat, without distortion, and show no evidence of curling.

Table I. Physical requirements

| Characteristics   | Requirement      |
|---|------------------|
| Weight per square yard (ounces) (minimum)                   | 5.5              |
| Yarns per inch (minimum)                                    |                  |
| Warp  | 85               |
| Filling   | 50               |
| Breaking strength (pounds) (minimum)                        |                  |
| Warp  | 160              |
| Filling   | 80               |
| Tearing strength (pounds) (minimum)                         |                  |
| Warp  | 12.0             |
| Filling   | 12.0             |
| Air permeability (ft. <sup>3</sup> /min./ft. <sup>2</sup> ) | 30 min., 90 max. |
| Flame resistance (warp direction only)                      |                  |
| Flame time, seconds (maximum)                               | 2                |
| Glow time, seconds (maximum)                                | 8                |
| Char length, inches (maximum) average                       | 3.5              |

3.7 Electrostatic decay. The finished cloth, when charged toward 5000 volts, shall reach a minimum level of 3800 volts and shall dissipate 90 percent of this charge within 0.50 second (decay time of less than 0.50 second). The average warp results and average filling results shall meet these requirements before and after five launderings when tested as specified in 4.5.

3.8 pH value. The pH value of the water extract of the finished cloth shall be no less than 4.0 nor more than 8.0 when tested as specified in 4.5.

3.9 Dimensional stability. The cloth shall not shrink more than 4.0 percent in the direction of the warp nor more than 2.0 percent in the direction of the filling after five launderings when tested as specified in 4.5.

3.10 Seam efficiency. The finished cloth shall have a seam efficiency of not less than 80 percent when tested as specified in 4.5.

3.11 Length and put up. Unless otherwise specified (see 6.2), the finished cloth shall be furnished in continuous lengths, each not less than 40 yards. Each length shall be put up in full width rolls as specified in FED-STD-802.

3.12 Fiber identification. Each roll shall be labeled and ticketed for fiber content in accordance with the Rules and Regulations Under the Textile Fiber Products Identification Act.

3.13 Face identification. The face side of the cloth shall be identified with the word "face" stamped at each end of the roll.

3.14 Workmanship. The finished cloth shall conform to the quality of product established by this specification. The occurrence of defects shall not exceed the point level specified.

3.15 Metric products. Products manufactured to metric dimensions will be considered on an equal basis with those manufactured using inch/pound units, provided they fall within the tolerances specified using conversion tables contained in the latest revision of FED-STD-376, and all other requirements of this specification are met.

3.16 Recovered materials. The contractor is encouraged to use recovered material in accordance with Federal Acquisition Regulation 23.4 to the maximum extent practical.

#### 4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his/her own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.1.2 Certification of compliance. When certificates of compliance are submitted, the Government reserves the right to check test such items to determine the validity of the certification (see 4.3.1).

4.2 Sampling for inspections and tests. Sampling for inspections and tests shall be made in accordance with MIL-STD-105. The inspection level and acceptable quality level (AQL) shall be as specified. All cloth manufactured at one time shall be considered a lot for purposes of inspection and test. Cloth samples shall be as specified in 4.3.2 and 4.5.

4.3 Quality conformance inspection. Each end item lot shall be sampled and inspected as specified in 4.3.2. Each lot shall be sampled and test as specified in 4.5. Test reports showing compliance with 4.5 shall be submitted as part of quality conformance inspections. The packaging shall be inspected as specified in 4.4. Packaging is not required when first articles are presented. When conducting quality conformance inspections of first articles the presence of any defect or failure of any test shall be cause for rejection of the first article.

4.3.1 Certification. As part of first article presentations and lot inspections, certificates of compliance shall be submitted to verify the characteristics of the aramid cloth, including the blend, denier, non-charring properties, and conductive fiber (see 3.3.1).

4.3.2 End item examination. The examination of the end item shall be in accordance with the provisions of 4.3.2.1 through 4.3.2.4.

4.3.2.1 Yard-by-yard examination. Each roll in the sample shall be examined on the face side only. When the total yardage in the roll does not exceed 100 yards, the entire yardage in the roll shall be examined. When the total yardage in the roll exceeds 100 yards, only 100 yards shall be examined. The sample size shall be in accordance with the following:

| <u>Lot size</u> | <u>Sample Size (rolls)<sup>1/</sup></u> |
|-----------------|---|
| 3,200 or less   | 8                                       |
| 3,201 to 10,000 | 13                                      |
| Over 10,000     | 20                                      |

All defects as defined in section III of FED-STD-4 that are clearly noticeable at normal inspection distance (3 feet) shall be scored and assigned demerit points as listed in 4.3.2.1.1 except as follows:

- a. Only coarse yarns that exceed twice the normal yarn diameter shall be scored.
- b. Mixed filling (shade bar) shall be scored only when resulting from wrong ply, wrong twist in the yarn, or off shade yarn.
- c. Only knots and slubs that exceed limits shown on Sears Fabric Defect Scales (see 2.2) "F" for slubs and "D" for knots shall be scored.

<sup>1/</sup> No more than one roll shall be taken from any shipping container unless the number of shipping containers in the lot is less than the required number of rolls, in which case all shipping containers shall be present in the sample.

No linear yard (increments of 1 yard on the measuring device of the inspection machine) from any one roll within the sample shall be penalized more than 4 points. The sample size shall be 20 rolls selected from 20 containers. The lot shall be unacceptable if the points per 100 square yards of the total yardage examined exceed 50 points. The lot shall be unacceptable if the points per 100 square yards of two or more individual rolls exceed 75 points. If one roll exceeds 75 points per 100 square yards, a second sample of 20 rolls shall be examined only for individual roll quality. The lot shall be unacceptable if one or more rolls in the second samples exceeds 75 points per 100 square yards. Point computation for lot quality and individual roll quality shall be as follows:

$$\frac{\text{Total points scored in sample} \times 3600}{\text{Contracted width of cloth (inches)} \times \text{total yards inspected}} = \text{Points per 100 square yards}$$

4.3.2.1.1 Demerit points. Demerit points shall be assigned as follows:

|   |          |
|---|----------|
| For defects 3 inches or less in any dimension                               | 1 point  |
| For defects exceeding 3 inches, but not exceeding 6 inches in any dimension | 2 points |
| For defects exceeding 6 inches, but not exceeding 9 inches in any dimension | 3 points |
| For defects exceeding 9 inches in any dimension                             | 4 points |

The following defects, when present, shall be scored 4 points for each yard in which they occur:

- Objectionable odor.
- Baggy, ridgy, or wavy cloth.
- Uneven weaving.
- Edge ravel when pulled outwards.
- Slack or tight selvages.<sup>1/</sup>

<sup>1/</sup> To determine the presence of unacceptable selvage conditions, the following procedure shall be observed: During the visual examination, the perch shall be stopped a minimum of three times for each roll in the sample, the tension removed, and the finished cloth examined for the selvage conditions. A waviness or ripples within the body of the cloth is an indicator of slack or tight selvage.

#### 4.3.2.2 Length examination

4.3.2.2.1 Individual rolls. During the yard-by-yard examination, each roll in the sample shall be examined for length. Any length found to be less than the minimum specified or more than 2 yards less than the length marked on the ticket shall be considered a defect with respect to length. The lot shall be unacceptable if two or more rolls in the sample are defective with respect to length.

4.3.2.2.2 Total yardage in sample. The lot shall be unacceptable if the total of the actual lengths of rolls in the sample is less than the total of the lengths marked on the roll tickets. The rolls examined shall be those selected for the examination of individual rolls.

4.3.2.3 Shade examination. During the yard-by-yard examination, each roll in the sample shall be examined for shade on the face side. When two or more rolls in the sample are off shade, shaded side to side, side to center, or end to end, it shall be cause for rejection of the entire lot represented by the sample.

4.3.2.4 Roll marking examination. During the yard-by-yard examination each roll in the sample shall be examined for the following listed defects:

- a. Face stamping missing from either or both ends.
- b. Face stamping on wrong side.
- c. Not labeled in accordance with the Rules and Regulations Under the Textile Fiber Products Identification Act.

Any roll not labeled or marked in accordance with the above shall be a defect. The lot shall be unacceptable if two or more of these defects occur.

4.4 Packaging examination. An examination shall be made in accordance with the provisions of FED-STD-802 to determine that packaging, packing, and marking comply with the section 5 requirements of this specification.

4.5 End item testing. The methods of testing specified in FED-STD-191, wherever applicable, as listed in table II shall be followed. The physical and chemical values specified in section 3, except where otherwise specified, apply to the results of the determinations made on a sample unit for test purposes as specified in the applicable test method. The sample unit shall be 5 continuous yards, full width, of the dyed and furnished cloth. All test reports shall contain the individual values utilized in expressing the final result. The lot size shall be expressed in units of 1 yard. The lot shall be unacceptable if one or more units fail to meet any of the requirements specified. The sample size (number of sample units) shall be as follows:

| <u>Lot size (yards)</u>        | <u>Sample size</u> |
|--------------------------------|--------------------|
| 800 or less                    | 2                  |
| 801 up to and including 22,000 | 3                  |
| Over 22,000                    | 5                  |

4.5.1 Curling. Two specimens of cloth shall be cut 1-1/2 inches by 6 inches. One specimen shall be cut with the 6-inch dimension in the warp direction and the second specimen shall be cut with the 6 inch dimension in the filling direction. Both specimens shall be placed on a dry flat surface, at normal room temperature, for a minimum of 5 minutes and shall show no evidence of curling. Any evidence of curling shall constitute a defect.

Table II. Test methods

| Characteristic          | Specification requirement | Reference Test method |
|-------------------------|---------------------------|-----------------------|
| Material identification |                           |                       |
| Aramid                  |                           |                       |
| Blend                   | 3.3.1                     | <u>1/</u>             |
| Denier                  | 3.3.1                     | <u>1/</u>             |
| Staple length           | 3.3.1                     | Visual <u>2/</u>      |
| Non-charring            | 3.3.1                     | <u>1/</u>             |
| Conductive fiber        | 3.3.1                     | <u>1/</u>             |
| Yarn                    |                           |                       |
| Plys (warp and filling) | 3.3.2                     | Visual <u>2/</u>      |
| Colorfastness to:       |                           |                       |
| Light                   | 3.4.2                     | 5660 <u>3/</u>        |
| Laundering              | 3.4.2                     | 5610 <u>4/</u>        |
| Weight                  | 3.5                       | 5041                  |
| Yarns per inch:         |                           |                       |
| Warp                    | 3.5                       | 5050                  |
| Filling                 | 3.5                       | 5050                  |
| Breaking strength:      |                           |                       |
| Warp                    | 3.5                       | 5100                  |
| Filling                 | 3.5                       | 5100                  |
| Tearing strength:       |                           |                       |
| Warp                    | 3.5                       | 5132                  |
| Filling                 | 3.5                       | 5123                  |
| Air permeability        | 3.5                       | 5450                  |
| Flame resistance        | 3.5                       | 5903 <u>5/</u>        |
| Weave                   | 3.5.1                     | Visual <u>2/</u>      |

Table II. Test methods - Continued

| Characteristic              | Specification requirement | Reference Test method            |
|-----------------------------|---------------------------|----------------------------------|
| Nonfibrous material         | 3.6.1                     | 2611                             |
| Curling                     | 3.6.2                     | 4.5.1                            |
| Electrostatic decay:        |                           |                                  |
| Before laundering           | 3.7                       | 5931 <u>6/</u>                   |
| After 5 launderings         | 3.7                       | 556 <u>6/</u> and 5931 <u>6/</u> |
| pH                          | 3.8                       | 2811                             |
| Dimensional stability after |                           |                                  |
| Five launderings            | 3.9                       | 5556 <u>6/</u>                   |
| Seam efficiency             | 3.10                      | 5110 <u>7/</u>                   |

1/ Unless otherwise specified, a certificate of compliance shall be submitted and will be acceptable for the stated requirements (see 4.3.1).

2/ One determination shall be made from each sample unit and the results reported as “pass” or “fail.”

3/ Except that the specimens shall be compared with the standard sample after 6 hours and evaluated.

4/ Test to be performed after five laundering cycles.

5/ The sample size for flame resistance shall be as specified. The sample unit for the additional required samples shall be 1 yard.

6/ Cotton laundering procedures.

7/ The needle shall measure 0.044 inch (plus or minus 0.001) across the blade at the eye. The thread for the needle shall be T 50 and the thread for the looper shall be T 35 of MIL-T-44100.

## 5. PACKAGING

5.1 Put-up and packaging. Put-up and preservation shall be level A or Commercial in accordance with FED-STD-802 as specified in 6.2.

5.2 Packing. Packing shall be level A, B, or Commercial in accordance with FED-STD-802 and as specified in 6.2.

5.3 Marking. In addition to any special marking required by the contract or purchase order, shipments shall be marked in accordance with applicable requirements of FED-STD-802.

## 6. NOTES

6.1 Intended use. The cloth is intended for use in manufacturing protective shirts worn by men and women engaged in wildland fire suppression work and controlled burn operations.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number, and date of this specification.
- b. When first article is not required (see 3.1, 4.3, and 6.5).
- c. Color of cloth required if other than specified (see 3.4).
- d. Width of cloth required (see 3.5.2).
- e. Length required if other than specified (see 3.11).
- f. Arrangements for inspection and tests (see section 4).
- g. Selection of applicable levels of packaging and packing (see 5.1 and 5.2).

6.3 Standard sample. Standard samples may be obtained from the preparing activity (see 6.7).

6.4 Cloth. The cloth has been successfully manufactured with yarns produced from and intimate fiber blend of 93 percent Nomex, 5 percent Kevlar, and 2 percent P140. This fiber blend is available in bale form from E.I. du Pont de Nemours & Co., Inc., Wilmington, DE 19880.

6.5 Cloth construction. The cloth requirements were based on a construction using 37/2 warp and filling yarn.

6.6 First article. When a first articles is required, it shall be inspected and approved under the appropriate provisions of FAR 52.209. The first article shall be a preproduction sample consisting of 5 continuous yards of the finished cloth. The contracting officer should include specific instructions in all acquisition documents regarding arrangements for selection, inspection, and approval of the first articles.

6.6 Notice. When Government drawings, specification, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever.

6.7 Preparing activity. USDA Forest Service, Missoula Technology and Development Center, Building 1, Fort Missoula, Missoula, MT 59801-7294.

3200-070

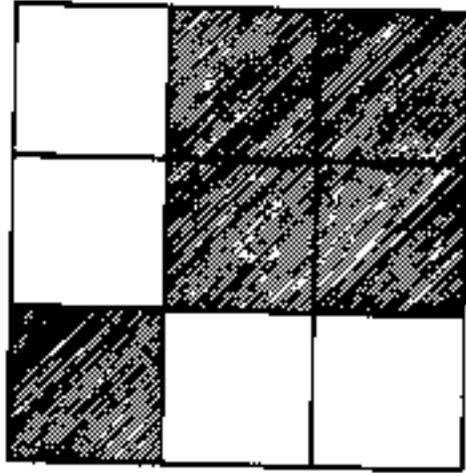


Figure 1. - Wave Diagram

# Standardization Document Improvement Proposal

This form is provided to solicit beneficial comments that may improve this document and enhance its use. Contractors, government activities, manufacturers, vendors, and users are invited to submit comments to:

USDA Forest Service  
Missoula Technology and Development Center  
Bldg. 1, Fort Missoula  
Missoula, MT 59804-7294

Attach any additional pertinent information that may be of use in improving this document to this form and mail in an envelope. A response will be provided when the submitter includes their name and address.

NOTE: This form shall not be used to submit requests for waivers, deviations, or clarification of specification requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the document, or to amend contractual requirements.

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Give paragraph number and wording: \_\_\_\_\_

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